

ORIGINAL ARTICLES

EXPERIMENTAL YELLOW FEVER AT THE INOCULATION STATION OF THE SANITARY DEPARTMENT OF HAVANA WITH A VIEW TO PRODUCING IMMUNIZATION.<sup>1</sup>

BY  
JOHN GUITERAS, M.D.,  
of Havana, Cuba.

Professor of General Pathology and of Tropical Medicine in the University of Havana; Director of the Inoculation Station at Las Animas Hospital.

The favorable results obtained by the United States Army Commission in their experiments with yellow fever; the continued series of mild cases resulting from these experiments without a death, suggested, very naturally, the continuation of their work on a larger scale; not with a view to control or confirm the conclusions of the

following grounds: (1) The series of mild cases obtained by the Commission; (2) the control over the number of bites; that is, the subject would be bitten but once by infected mosquitos, whereas, in an infected house, the subject would be exposed to successive bites; (3) the patient would be cared for during the period of incubation, and immediately upon the invasion of the disease; and, finally, the patient would be treated from the beginning in a mosquito-proof house, where he would be a source of danger to no one.

Taking all these facts into consideration, the Chief Sanitary Officer of Havana, Major W. C. Gorgas, U. S. A., decided to establish an inoculation station in connection with the hospital Las Animas. The support of General Wood, the Military Governor of the Island, was obtained, and it may be stated that the liberal policy of this officer, and his special fitness, as a physician, to grasp the importance of the problems involved, have made their solution possible. The station and the laboratory

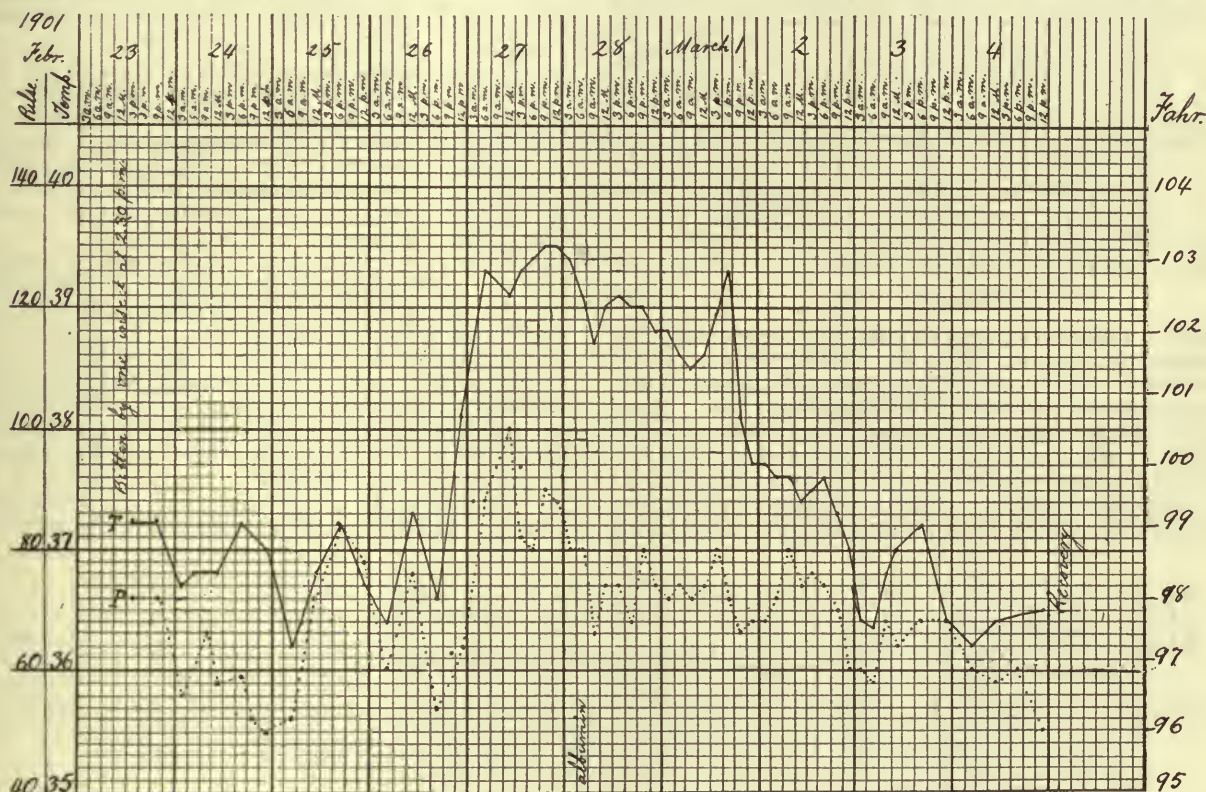


Chart I. Vergara.

Commission, for any one who had followed their work with unprejudiced attention must have concluded that their solution of the problem of the etiology of yellow fever was final; but rather with the hope of propagating the disease in a controllable form, and securing, among the recently arrived immigrants, immunization, with the minimum amount of danger to themselves and to the community.

There was, indeed, no satisfactory ground upon which to base the opinion that the experimental yellow fever must always be mild; for, we should not forget that, though we call the results of these experiments, experimental yellow fever, yet, strictly speaking, the process is the natural one. The disease was conveyed through the natural medium, the mosquito, from the sick to the well, precisely as it would have been conveyed if the immigrant had taken his residence in one of the mosquito-infected houses of Havana.

We hoped that the results would be favorable, on the

attached to it were placed under my direction. In conducting its operations I always received counsel and support from Dr. Charles Finlay, Major W. C. Gorgas, and Dr. A. Diaz Albertini, who, with myself, constitute the Yellow Fever Board of Havana. Nor could the investigation have been carried out without the kind cooperation of the director of Las Animas Hospital, Major J. W. Ross, U. S. N.

The inoculation station was opened in February of the present year. A large number of larvae of *Stegomyia taeniata*<sup>1</sup> was secured, and breeding jars were started in order to have a constant supply of young

<sup>1</sup> The name of the yellow fever mosquito has not been definitely settled. It was called *Culex mosquito* by Finlay, who believed it to correspond with the species of that name, described by Desvoidy. The U. S. Army Commission adopted the name *Culex fasciatus*, a species described by Fabricius. *Culex taeniatus*, Meigen, has also been suggested. The best description of the insect, that has come to my notice, is that of Fecalbi, who names it *Culex elegans*. It is probable that all these names have been employed for the same species. Mr. Theobald, who is a specialist on mosquitos, and a great authority in matters of classification, has decided that the yellow fever mosquito must be separated from the genus *Culex*. He has placed it in a new genus to which he has given the name *Stegomyia*. We may use, therefore, for our insect the name *Stegomyia taeniata* or *fasciata*. We cannot help regretting that the name of Finlay is not used in naming this insect.

<sup>1</sup> Published synchronously in Spanish in the *Revista de Medicina Tropical*, of Havana, Cuba.



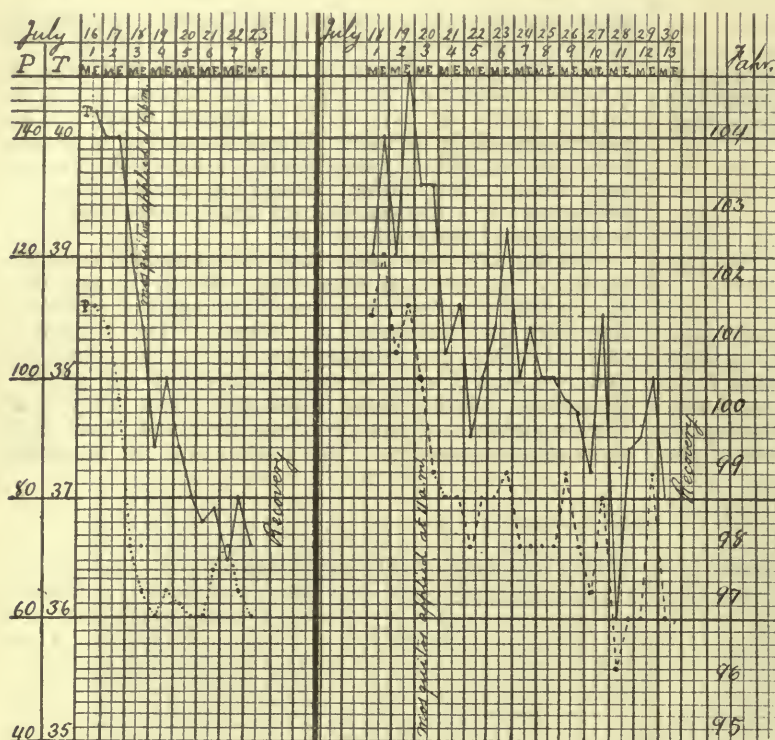


Chart II. Fernandez. Chart III. Alvarez. Infecting Case.

insects. These were kept in glass jars large enough for a patient to introduce the hand. When a case of yellow fever was reported, one of these jars, containing about 20 female insects, was taken to the bedside. The patient, passing his hand through a gauze sleeve attached to the mouth of the vessel, and held close around the arm, allowed his hand to rest for a few minutes within the jar. As a rule the majority of the insects were found to have filled. The jar and sleeve were then carefully withdrawn,

to prevent the escape of the insects, and the whole was taken back to the laboratory. There a small dish of water was placed at the bottom of the jar, and a lump of sugar was hung from the top in a small bag of gauze. The sleeve was then tied up with a bit of string. It then became necessary to wait for the period of from 12 to 17 days to pass before the insects became pathogenic.

Before taking up the consideration of the cases inoculated at the station, I shall discuss briefly two problems that suggest themselves concerning the infection of the mosquito. In the first place, it has been suggested by some who evidently ignore the results of the direct blood inoculations made by the United States Army Commission, that the mosquito becomes infected, not from the blood of the patient, but from his secretions, his discharges, or something else in the room occupied by him. In that case, the jar itself into which the patient introduces the hand, might become infected. This was tested accidentally in the case of the mosquitos from Alvarez. The insects were removed from the original jar, and other insects, that took their place, were used for breeding, and fed upon non-immunes with impunity.

The second problem refers to the transmission of the infection to the progeny of the mosquito. With respect to this question I can report 2 experiments with negative results. The progeny of the insect that infected Vergara (Case 2 of the Table) was kept in a separate jar, and was tried without results, upon 3 nonimmunes. The large brood from the mosquitos of Alvarez (all infected) was transferred to the breeding jars, and there have fed upon nonimmunes with impunity.

I shall now give, in tabular form, the series of trials made at the station. The heading of the eighth column

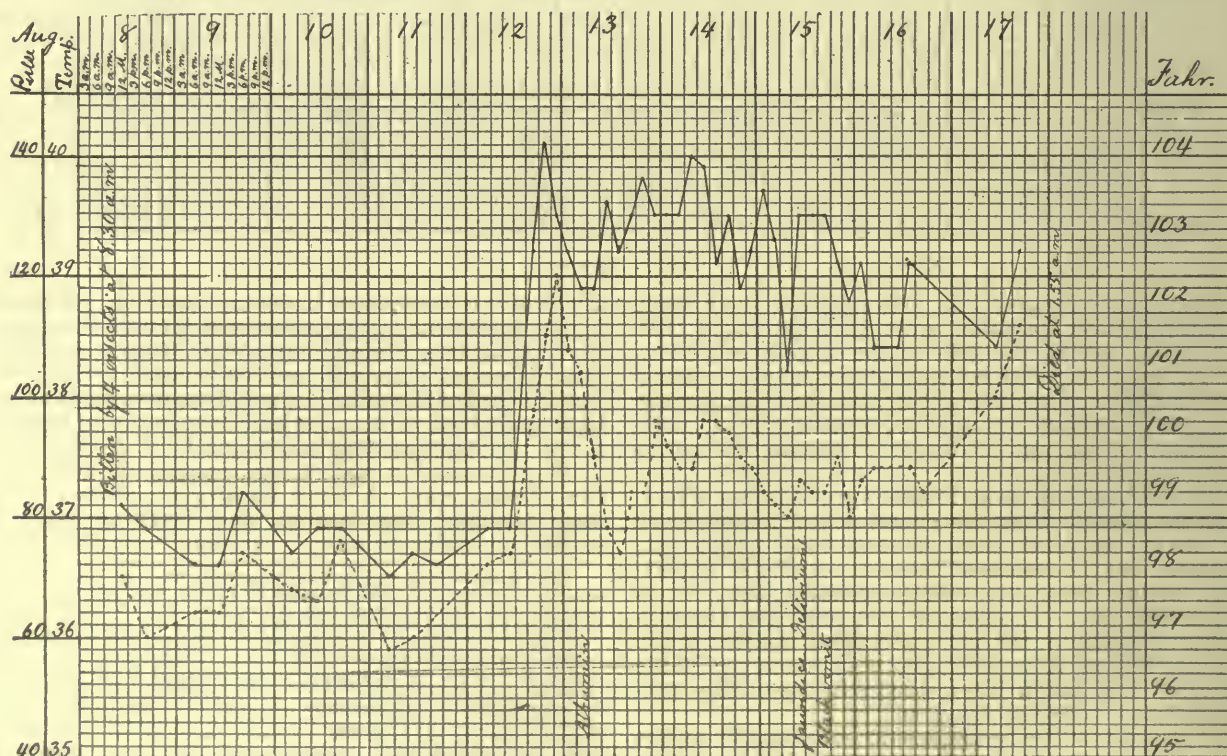


Chart IV. Carro.



of the table is the only one that requires an explanation. This column contains the formula that I have adopted to present in a graphic form the 2 important facts in the history of each insect. I use for this purpose, as a symbol, the figure of a fraction, in which the numerator represents, in Roman numbers, the day of the disease of the infecting patient at the time when the insects are applied to him; and the denominator represents the number of days that have passed since the insect became infected by such application. The denominator, therefore, changes with each day that passes in the evolution of the infection in the body of the mosquito. So far as we may conclude from the small number of experiments made, it appears that an insect, to become infected, must bite the patient having yellow fever on the first, the second or the third day of the disease; this date is expressed by the numerator. A mosquito so infected cannot communicate the disease until a period of more than 12 days has passed since the insect became infected; this period is expressed by the denominator. Twelve

were sharp ephemeral fevers, or cases of grip that presented some initial symptoms suspicious of yellow fever.

I shall consider first the large number of failures included in the table. Why these failures? I must acknowledge that some of the original or infecting cases that furnished the presumable infection for the mosquitos used in the first 25 cases of the series, were doubtful cases. These are Stewart, Jensen, Martinez, Rodriguez and Brennan. The diagnosis in all these was made with some hesitation. I am personally of the opinion that they were cases of yellow fever, but must admit the possibility of a mistake in diagnosis. They certainly were all very mild cases.

The season of the year may be advanced as an explanation of these failures. Cases of yellow fever are rare at that time of the year, and were especially so this spring, and the conclusion suggests itself that the environment is unfavorable to the evolution of the parasite in the body of the mosquito. But there is every reason to believe that the infrequency of yellow fever at

TABLE OF INOCULATIONS.

Number of Case.	Date of Inoculation.	Name of Subject Inoculated.	Name of Patient from whom the Infection is Derived.	Date of Attack of Patient from whom the Infection is Derived.	Date of Application of Mosquitos to the Infecting Patient.	Number of Mosquitos used for Inoculation.	Formula.	Results, with Period of Incubation.
1	Feb. 22, 4 p.m.	Gros.	(?)	Feb. 6.	Feb. 9, 4 p.m.	1	III/13	Failed.
2	Feb. 23, 2.45 p.m.	Vergara.	J. H. A.	Jan. 28, 1.15 p.m.	Jan. 28, 9.15 p.m.	1	I/26	Yellow fever 3 days 10 hours after inoculation.
3	Mar. 8, 10.30 a.m.	Quintillan.	Linares or Vergara. Doubtful Insect.	Feb. 24, 6 a.m., or Feb. 26, 12 night.	Feb. 27, 11 a.m., or Feb. 28, p.m.	1	IV/9 or II/8	Failed.
4	Mar. 17, 9.30 a.m.	Gros.	Vergara.	Feb. 26, 12 night.	Feb. 28, p.m.	1	II/17	Failed.
5	Mar. 17, 9.15 a.m.	Maass.	Vergara.	Feb. 26, 12 night.	Feb. 28, p.m.	1	II/17	Failed.
6	Mar. 17, 9.45 a.m.	Represas.	Same as Case 3.	Same as Case 3.	Same as Case 3.	1	IV/18 or II/17	Failed.
7	Mar. 25, 5.10 p.m.	Maass.	Vergara.	Feb. 26, 12 night.	Feb. 28, p.m.	1	II/25	Failed.
8	Mar. 26 (?)	Martinez.	Stewart.	Mar. 8, a.m.	Mar. 9, 4 p.m.	1	II/16	Failed.
9	Mar. 31, 5.10 p.m.	Represas.	Same as Case 3.	Same as Case 3.	Same as Case 3.	1	II/25 or IV/26	Failed.
10	Apr. 14, 4 p.m.	Gros.	Same as Case 3.	Same as Case 3.	Same as Case 3.	1	II/30 or IV/31	Failed.
11	Apr. 20, 11.30 a.m.	Santiso.	Jensen.	Mar. 28, 6 p.m.	Mar. 30, 11.30 a.m.	1	II/15	Failed.
12	Apr. 25, 4.50 p.m.	Carro.	Jensen.	Mar. 28, 6 p.m.	Mar. 30, 11.30 a.m.	1	II/21	Failed.
13	May 1, 7 a.m.	Taylor.	Same as Case 3.	Same as Case 3.	Same as Case 3.	1	II/50 or IV/51	Failed.
14	May 8.	Taylor.	Jensen.	Mar. 28, 6 p.m.	Mar. 30, 11.30 a.m.	1	II/25	Failed.
15	May 15.	Taylor.	Same as Case 3.	Same as Case 3.	Same as Case 3.	1	II/55 or IV/56	Failed.
16	May 15, 4.15 p.m.	Maass.	Martinez.	Apr. 21, 11.20 a.m.	Apr. 22, 2 p.m.	3	II/9	Failed.
17	May 16.	Santiso.	Martinez.	Apr. 21, 11.20 a.m.	Apr. 22, 2 p.m.	3	II/17	Failed.
18	May 24, 4 p.m.	Carro.	Martinez.	Apr. 21, 11.20 a.m.	Apr. 22, 2 p.m.	2	II/23	Failed.
19	May 27, 9.45 a.m.	Maass.	Rodriguez.	May 7, noon.	May 9, 11.30 a.m.	3	II/6	Failed.
20	May 29, 5 p.m.	Taylor.	Rodriguez.	May 7, noon.	May 9, 11.30 a.m.	2	II/7	Failed.
21	May 31, 10 a.m.	Vasquez.	Rodriguez.	May 7, noon.	May 9, 11.30 a.m.	2	II/16	Failed.
22	June 2, 10 a.m.	Santiso.	(?)	May 7, noon.	May 9, 11.30 a.m.	2	II/15	Failed.
23	June 2, 1 p.m.	Gros.	Rodriguez.	May 7, noon.	May 9, 11.30 a.m.	4	II/18	Failed.
24	June 4, 4 p.m.	Maass.	Rodriguez.	May 7, noon.	May 9, 11.30 a.m.	3	II/20	Failed.
25	June 7, 8.30 a.m.	Taylor.	Brennan.	May 12, 7 p.m.	May 13, 7 p.m. and May 14, 4 p.m.	4	II/22	Failed.
26	July 31, 10.30 a.m.	Campa.	Abego.	July 23, 7.30 a.m.	July 25, 12.30 p.m.	4	III/5	Failed.
27	Aug. 4, 11.30 a.m.	Martin.	Fernandez.	July 16, 6.30 p.m.	July 18, 6 p.m.	3	II/17	Failed.
28	Aug. 4, 1 p.m.	Varela.	Fernandez.	July 16, 6.30 p.m.	July 18, 6 p.m.	4	II/17	Failed.
29	Aug. 7, 7 a.m.	Taylor.	Fernandez.	July 16, 6.30 p.m.	July 18, 6 p.m.	5	II/20	Failed.
30	Aug. 8, 8.30 a.m.	Carro.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	4	III/19	Yellow fever 4 days 5 hours after inoculation.
31	Aug. 8, 9.30 a.m.	Represas.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	4	III/19	Yellow fever 3 days 3 hours after inoculation.
32	Aug. 7, 6 p.m.	Holmes.	Abego.	July 23, 7.30 a.m.	July 25, 12.30 p.m.	1	III/14	Failed.
33	Aug. 8, 7 a.m.	Abego.	Abego.	July 23, 7.30 a.m.	July 25, 12.30 p.m.	1	III/14	Failed.
34	Aug. 9, 9 a.m.	Campa.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	3	III/20	Yellow fever 5 days 3 hours after inoculation.
35	Aug. 10, 9 a.m.	Migues.	Fernandez.	July 16, 6.30 p.m.	July 18, 6 p.m.	3	II/22	Failed.
36	Aug. 10, 10 a.m.	Thomlins'n.	Fernandez.	July 16, 6.30 p.m.	July 18, 6 p.m.	2	II/22	Failed.
37	Aug. 10, 10.30 a.m.	Domínguez.	Abego.	July 23, 7.30 a.m.	July 25, 12.30 p.m.	4	III/15	Failed.
38	Aug. 13, 1.45 p.m.	Taylor.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	1	III/24	Yellow fever 3 days 19 hours after inoculation.
39	Aug. 13, 2.30 p.m.	Martin.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	2	III/24	Failed.
40	Aug. 14, 9 a.m.	Maass.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	2	III/24	Yellow fever 3 days 21 hours after inoculation.
41	Aug. 14, 10.15 a.m.	Varela.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	3	III/24	Yellow fever 5 days 21 hours after inoculation.
42	Aug. 22, 4.30 p.m.	Alonso.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	2	III/34	Yellow fever 3 days after inoculation.
43	Aug. 24, 3 p.m.	Vicente.	Alvarez.	July 18, 9 a.m.	July 20, 11 a.m.	2	III/36	Failed.

days is the minimum, but higher figures, such as 17 days, are more common.

Beside those included in the table, 6 other attempts were made, but they are excluded because the original or infecting case proved not to be yellow fever. They

that time is rather due to the scarcity of mosquitos. The explanation, therefore, would not hold good in our cases, since we provided against the antagonism of the season by furnishing the mosquitos at the right time, and by breeding them at a summer temperature.



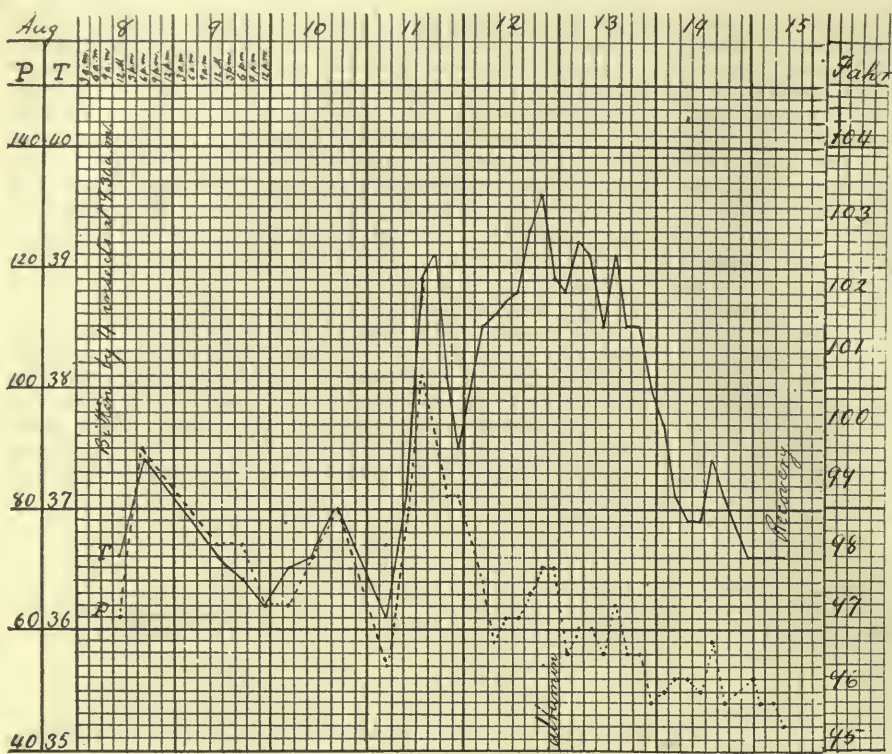


Chart V. Represas.

I have suggested, and I see from Dr. Reed's latest publication that he is of the same opinion, that the failures may be due to variations in the number of parasites found in the peripheral circulation of the infecting patient. In mild cases their presence in said circulation is perhaps restricted to short periods of time, and one can imagine that this period may be still further restricted by cold weather. The mosquito, under such

frontal headache 3 hour before the initial rise of the temperature. The face was suffused, and he presented from the first day a slight icteric discoloration of the conjunctiva. There was photophobia, repulsion of food and epigastric tenderness. On March 1, the elevation of the temperature was accompanied by a slight chill, and exacerbation of the headache. The albumin appeared as a very slight trace on the morning of February 28, and gradually increased, to reach a maximum of 30 centgr. on March 6, and to disappear on the tenth. The treatment was strictly expectant, with absolute rest in bed.

circumstances, would be less likely to become infected.  
The mosquito used in Case 3, frequently referred to in the table, was a doubtful insect. If it came from Linares, the source was an undoubted case of yellow fever, in its fourth day. If it came from Vergara, its source was an unquestionable case of mild character; but 2 other mosquitos from the same source proved themselves to be also not infected.

In this long list of failures of the first series, there is but one successful inoculation; and I shall conclude my observations on this series with a history of this case.

CASE I. — (Case 2 of the table). Chart I. Vergara was bitten February 23, at 2.45 p.m., by 1 mosquito infected January 23, at 9.15 p.m., from a case of the Army Commission, produced by the subcutaneous injection of blood from a yellow fever patient. The case from which the mosquito that bit Vergara took its infection was a severe one. It is described under the initials J. H. A., Case IV, in a paper by the Army Commission. See "Experimental Yellow Fever" in AMERICAN MEDICINE, July 6, 1901.

Vergara, aged 28 years, recently arrived from Spain, was taken sick February 26, about midnight, with a slight chill and headache. The case may be considered as typical of mild yellow fever. He complained of

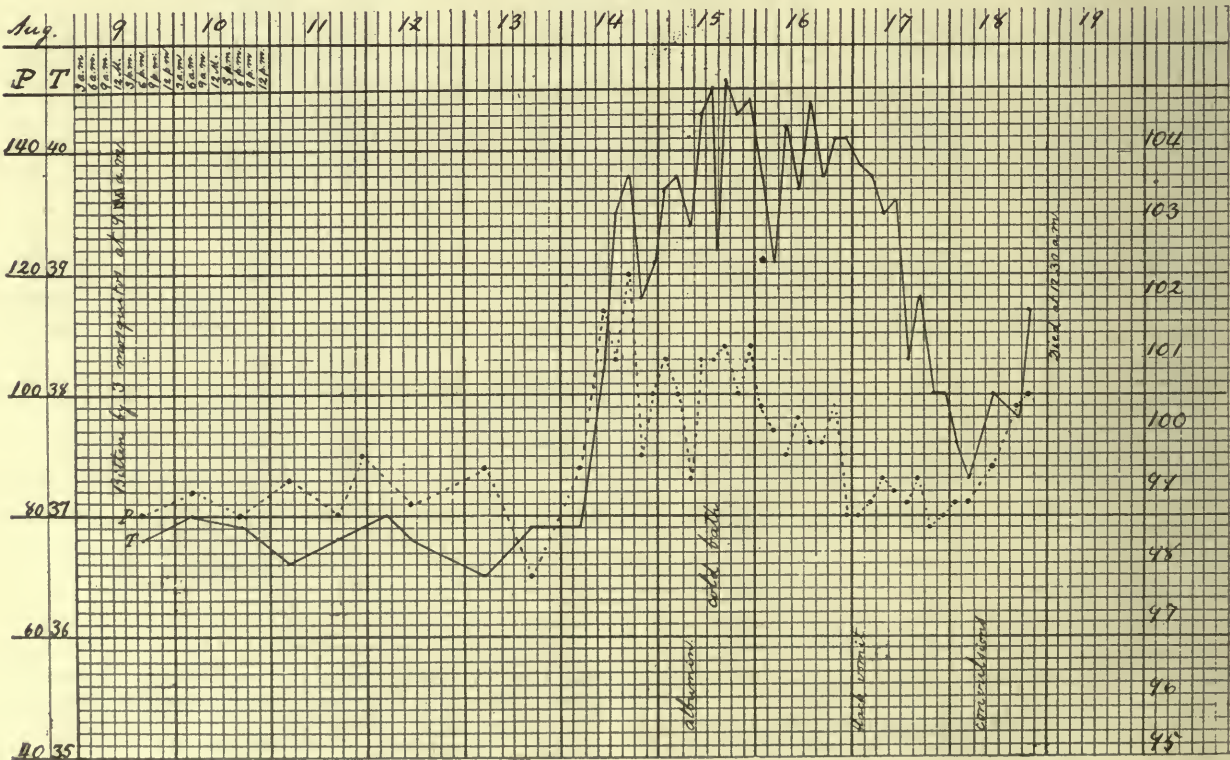


Chart VI. Campa.



In this case, as in all the other experimental cases, the Temperature Chart of the febrile period is preceded by the curve of the period of incubation. The blood was examined in all cases, and no malarial parasites were found.

I take up now the second series of cases, from the twenty-sixth on, beginning July 31. The sources of infection available at this time were 3 undoubted cases of yellow fever, namely, Abego, Fernandez and Alvarez. Abego's was a fatal case. The mosquitos derived from him, however, have not had a chance to show whether they were infected or not. They were used on the fifth, the fourteenth and the fifteenth day without success. We cannot say whether on the seventeenth day they might not have proved themselves to be pathogenic. Fernandez had a mild attack of the disease. The mosquitos derived from him have had a thorough trial. They evidently were not infected. The explanation of these failures, suggested earlier in this paper, may be the correct one, but I would add, in connection with this

to the maximum of 40.1. The headache was frontal and severe, the face was flushed, the eyes injected and half closed to shade the light. There was tenderness of the epigastrium, nausea, and pain in the limbs. Albumin in the morning of the second day. From the start the case was a violent one. Delirium, jaundice and black vomit presented themselves on the fourth day. The patient died early on the seventh day.

A postmortem examination showed, very decidedly, all the characteristic lesions of yellow fever.

CASE III.—(Case 31 of the table). Chart V. Represas, a Spaniard, aged 21 years. Residence on the island, 6 months. He was employed as a laborer in the hospital. He had been previously bitten on 2 occasions, without results. See Nos. 6 and 9 of the table.

On August 8, at 9.30 a. m., Represas was bitten by 4 mosquitos from Alvarez. Formula of the insects at the time, III/19. He was taken sick at noon on August 11. Loss of appetite and fall of the pulse were noticed in the morning, before the invasion. Severe frontal headache and marked congestion of the face; very slight jaundice; a trace of albumin appearing at the end of the second day and increasing subsequently; such, together with a very characteristic temperature and pulse curves, were the prominent features of the case. Termination in recovery.

CASE IV.—(Case 33 of the Table). Chart VI. Campa, a Spaniard, aged 22 years. Residence of 4 months on the island.

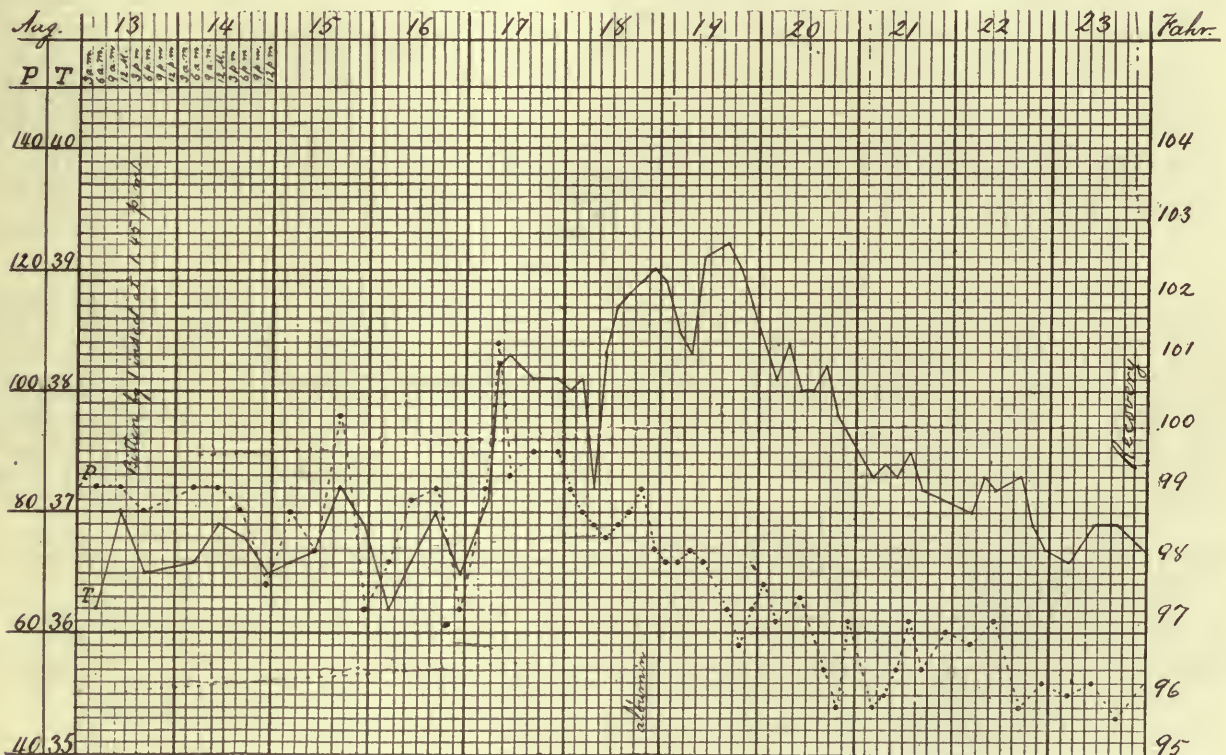


Chart VII. Taylor.

particular case, that Fernandez may have been sick longer than he knew, or was willing to admit. The onset in some of the mild cases, especially among the ignorant, is not always so sharp that the patient does not at times mistake the hour and even the day.

The mosquitos derived from Alvarez appear to have been all infected. I include the charts of the morning and evening temperatures of these 2 cases. Chart II of Fernandez, Chart III of Alvarez; and I proceed now to give, briefly, the history of all the cases derived from Alvarez.

CASE II.—(Case 30 of the table). Chart IV. Carro, a Spaniard, aged 21 years and employed in Las Animas Hospital. Residence in Cuba, 4 months. He had been bitten twice before without success. See numbers 12 and 18 of the table. On the present occasion he was bitten August 8 by 4 mosquitos from Alvarez. Formula of the insects at the time of the bite, III/19. On August 11 the patient complained of dizziness, and of heaviness of the limbs, but was not willing to stop the light work he was doing. The temperature and pulse were lower than on the preceding days. On the twelfth he had headache during the morning, and the temperature rose, between noon and 9 p. m.,

Employed as laborer in the hospital. Had been previously bitten once. See Case 26 of the Table.

On August 9, at 9 a. m., was bitten by 3 mosquitos from Alvarez. Formula of the insects at the time, III/20. He was taken sick at noon of August 14, but he complained of chilliness during the night, and there was a fall of the pulse on the preceding day. With the invasion, pains all over the body presented themselves, and soon after, photophobia, very intense injection of the face and the conjunctivas, with slight icteric discoloration of the latter. Albumin in the morning of the second day. Dulness of mind. On the fourth day he had black vomit: intense jaundice and convulsions on the fifth day, and he died early in the morning of the sixth day.

CASE V.—(Case 37 of the Table). Chart VII. Taylor, native of England, aged 33 years. Assistant in the inoculation station. Residence on the island, 4 months. He had been previously bitten on 6 occasions. See Nos. 13, 14, 15, 20, 25 and 29 of the Table.

On August 13, at 1.45 p. m., was bitten by 1 mosquito from Alvarez, being one of the 4 insects that had infected Carro. The formula of said insect was III/24. Taylor complained on August 16, throughout the day, of loss of appetite and vertigo. He had a slight chill on the night preceding, and the pulse fell on the 16th. The chart shows the mild but typical character of the disease. The most marked symptoms were frontal headache and extreme sensitiveness of the epigastrium. The albumin disappeared on August 23.



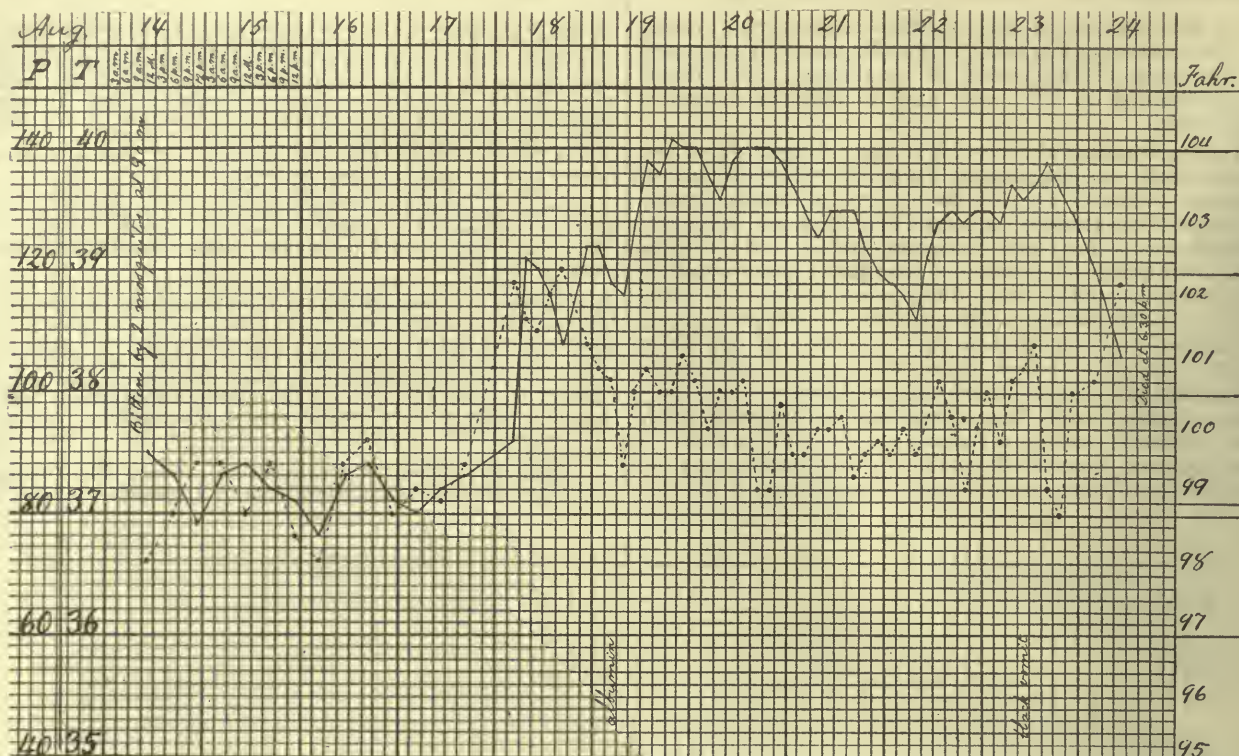


Chart VIII. Maass.

CASE VI.—(Case 39 of the Table). Chart VIII. Miss Maass, an American nurse, aged 25. Residence on the island, 10 months. She had been previously bitten 5 times. See Nos. 5, 7, 16, 19 and 24 of the Table. On August 14, at 9 a. m., she was bitten by 2 mosquitos from Alvarez, being 2 of the 4 mosquitos that had infected Represas. The formula was at the time III/24. She was taken sick on August 18, at 6 a. m., without any premonitory symptoms. The temperature was beginning to rise when she felt some chilliness and headache. The case was an intensely hemorrhagic one, and terminated fatally on the seventh day.

CASE VII.—(Case 40 of the Table). Chart IX. Varela, a Spaniard, aged 21 years. Residence on the island, 1 month. He was employed as laborer in the hospital. He had been previously bitten on 1 occasion. See No. 28 of the Table. On August 14, at 10.15 a. m., he was bitten by 3 mosquitos from Alvarez. Their formula at the time was III/24. Two of these insects had infected Campa, and the other had infected Carro. The invasion in this case was more gradual. He complained first of cephalalgia and rachialgia. On August 23 and 24 the vomit contained specks of blood. Throughout the height of the attack the urine had to be drawn by catheter. The patient recovered.

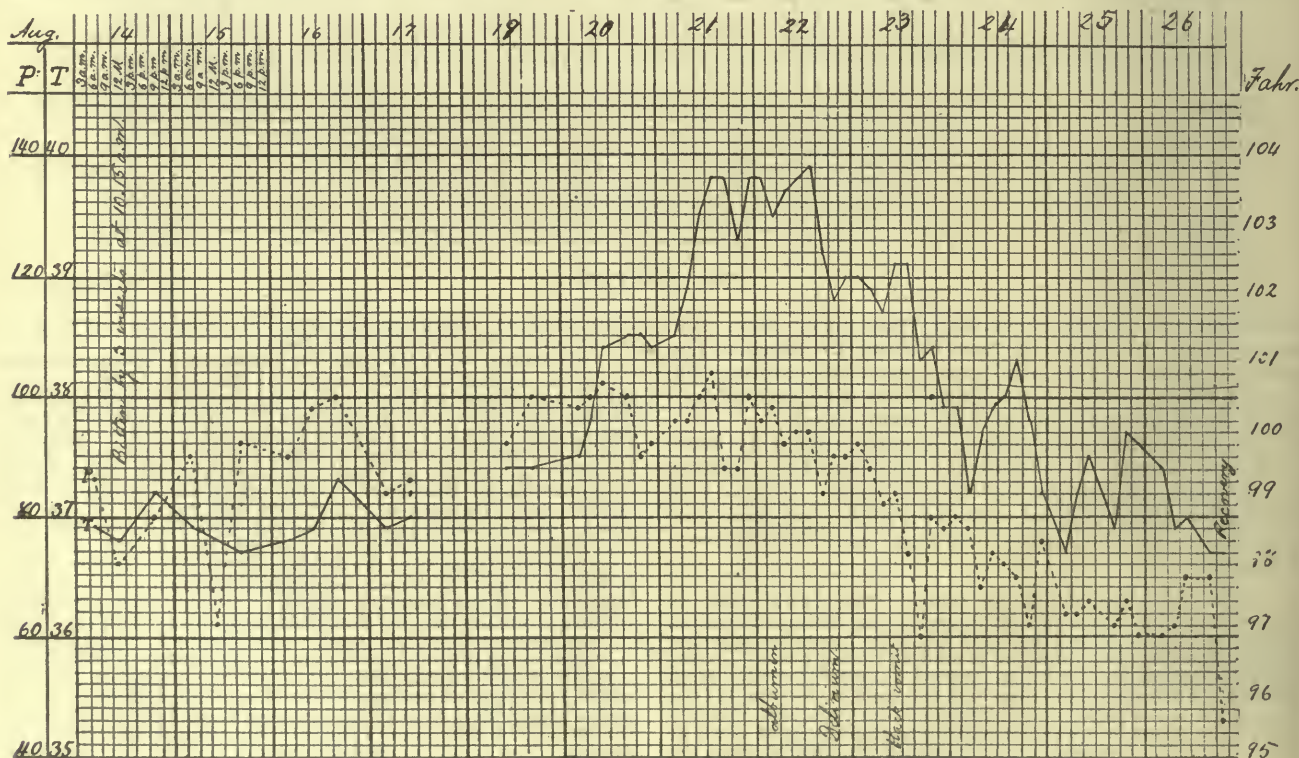


Chart IX. Varela.



CASE VIII.—(Case 41 of the Table.) Chart X. A special interest attaches to this case because the patient was subjected previously to the inoculation, to the alleged protective influence of Dr. Caldas' vaccine.

Alonso, a Spaniard, aged 21 years, received, on August 14, at 11.30 a. m., 12 cc. of Dr. Caldas' curative or antitoxic serum. The next day he received 3 cc. of the vaccine, injected by Dr. Caldas. On August 22 he was bitten, at 4.30 p. m., by 2 mosquitos from Alvarez. The formula was then 11/34. One of these insects had produced, with 3 others, a fatal case in Carro, and, alone, had produced a mild case in Mr. Taylor; the other insect was one of those that produced first a mild case in Represas, and subsequently a fatal case in Miss Maass. Alonso was taken sick at 4 p. m., August 25. The patient had frontal cephalalgia, congestion of the face and conjunctivas, slight jaundice, a large amount of albumin in the urine, pain and tenderness in the umbilical region, spongy gums, and the first stage of black vomit. He had no enlargement of the liver and spleen, and no malarial parasites in the blood. Dr. Caldas, who never took the trouble to study the symptoms, declared that the patient did not have yellow fever, but a putrid fever caused by the mosquito bites. The case was characteristic of severe yellow fever, ending in recovery.

It has not been my intention to dwell upon the clinical history of these cases. Those who are familiar

mathematical precision, are undoubtedly startling circumstances.

We should also consider that these charts give us something that is comparatively unknown—namely, the history of the initial rise of the temperature. This makes the record differ decidedly from the picture that we are accustomed to see. Furthermore, the careful record kept of these cases enables us to present the variations of the fever every 3 hours. Thus it is that the tracings may mislead, for a moment, the clinician who is used to the morning and evening records.

Then, certain symptoms, such as the albumin in the urine, the icterus, the fall of the pulse, seem to anticipate the usual time of their appearance. This is simply the result of the conditions surrounding the patient: the repose in bed from the very beginning of the invasion, and the careful looking for symptoms at frequent intervals.

In my opinion the cases are such as we would meet in any ordinary series of cases. There is nothing anom-

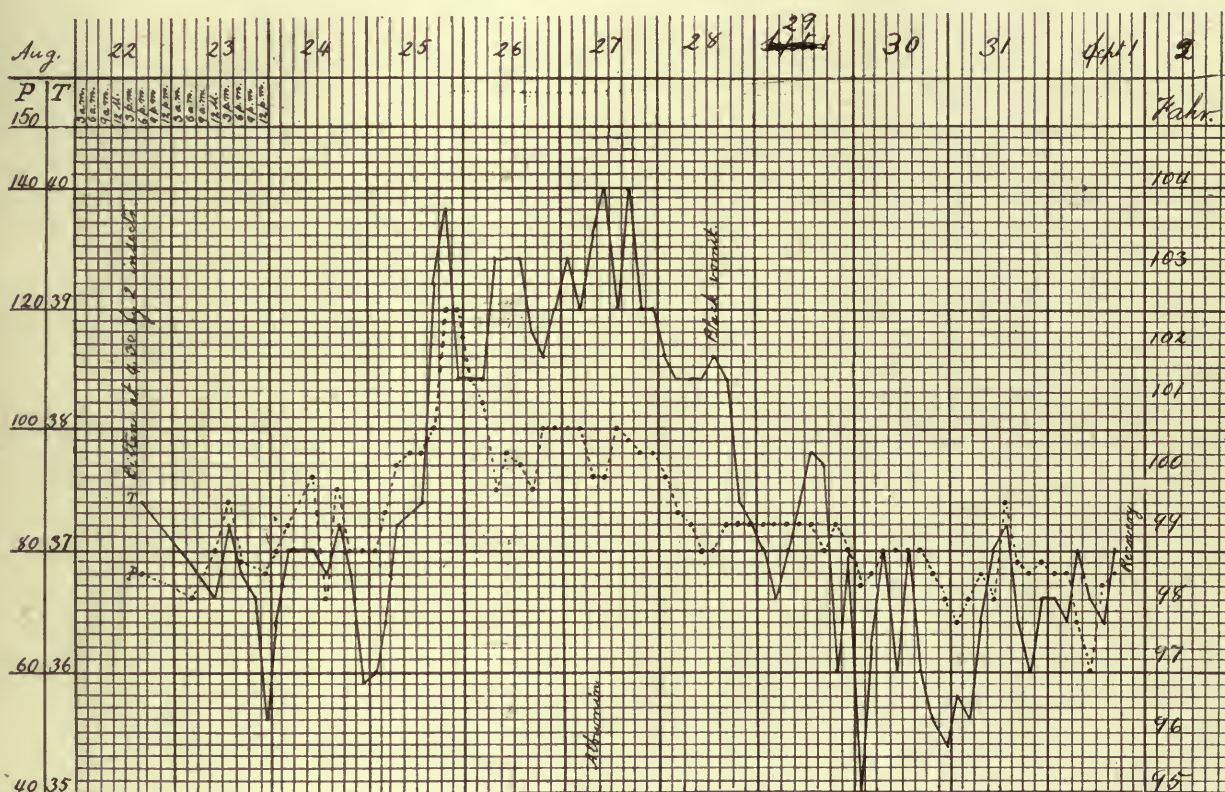


Chart X. Alonso.

with the disease will recognize it at once by inspection of the temperature charts, and by the symptoms I have mentioned. But I know there be some who say that this is not ordinary yellow fever. They find something unusual in these cases. They are the same who found it unusual in the cases of the United States Army Commission that they were all too mild. Now they argue that these cases are too violent. This attitude comes from the unwillingness to admit that the mosquito is the ordinary, and, much less, the only conveyor of the disease. While these observers believe that they notice first the anomalous clinical features, and that the cases must, therefore, proceed from unusual causes, they really are influenced primarily by the belief that the cause is abnormal, and, as a consequence, they find the anomalous features. The imagination is easily excited in the contemplation of these cases. To be shown today an individual, and to be told that he will have yellow fever tomorrow, and to have this statement verified with

alons in the 2 small experimental outbreaks produced in Havana by the United States Army Commission and by myself, except that they were started at will, and that they ceased with the last inoculation.

As I said before, the object of these experiments was not to confirm the conclusions of Drs. Reed, Lazear, Carroll, and Agramonte, but the results obtained should be utilized for that purpose. The very fact that we have produced all classes of yellow fever, from the extremely mild to the severe, the hemorrhagic, the uremic, the ataxic, throws the burden of proof upon those who still maintain that there must be some other means of conveyance.

During the time that the series of cases now reported was in progress, every opportunity was given for the transmission of the disease by other means than the bite of the mosquito. Case I, Vergara, was assigned to a mosquito-proof room immediately after the inoculation. In the same room with him was placed a nonimmune



Spaniard, who had arrived with him from Spain. They occupied the same room throughout the course of the disease and convalescence, without any manifestation on the part of the control. Six cases of the second series were treated in a large mosquito-proof building. This main building of Las Animas Hospital is a one-story structure divided into compartments that communicate freely with one another by large doors. During the development of our experimental epidemic, cases of other diseases were being treated in the same building, nonimmunes were allowed to visit the patients, non-immune nurses attended upon them, the majority of the attendants and laborers about the hospital were also non-immunes; and of all these, only those that were bitten by the mosquitos from Alvarez contracted the disease, in regular order, corresponding with the order of the inoculations, except in the cases of Carro and Represas, who, bitten on the same day, with 1 hour's interval, reversed the order because Represas had a shorter period of incubation than Carro. During this time no measure of prophylaxis was enforced other than the exclusion of the mosquitos by the wire gauze.<sup>1</sup>

It is true that during the natural epidemic of last year this hospital remained uninfected, though every ward was filled with yellow fever cases. But even then Dr. Finlay had shown us that this was due to the absence of the genus *Stegomyia* of mosquitos from the building used for the new admissions. In this building Dr. Finlay kept dishes of water, and we never found in them the eggs of the *Stegomyia*. The species *Culex pungens* was found in great numbers. All cases of fever remained in this building until the diagnosis of yellow fever was confirmed. They were then removed to the other buildings at a time when, probably, in most of said cases, the period had passed in which they were capable of infecting the mosquitos. It may be further stated that the *Stegomyia* was also quite scarce in the other buildings. The frequent arrival to the hospital of patients past this period probably explains why it is that these institutions often remain uninfected in the midst of epidemics.

It may be of interest to add that after the ending of our recent experimental outbreak, a very thorough disinfection (mosquito destruction) was made of several buildings, screened and unscreened, of Las Animas Hospital. The dead insects were brought to me for examination, and I found among 320 mosquitos of various kinds, mostly *pungens*, only 9 of the genus *Stegomyia*.

The last case of the series was not treated at Las Animas Hospital. Alonso was transferred, after the inoculation, to Hospital No. 1, in charge of Dr. Agramonte. This hospital is a large general hospital. The ward of Dr. Agramonte contains a series of wire cages, each large enough to contain 2 beds. The case of yellow fever was treated in one cage, while the adjoining cage was occupied by a nonimmune, whose bed was separated from that of the patient by the intervening wire screen. The nonimmune was not affected.

Since the opening of the Inoculation Station, I have been accumulating, unwittingly, a fine collection of fomites, and have kept them in a badly ventilated room at a summer temperature. I refer to the gauze sleeves about the mouths of my mosquito jars. These sleeves are made of cotton bobbinet and, I am sorry to say they are now rather dirty, so many hands—yellow fever hands and otherwise—have been going in and out during the last 6 months. In order to know how thoroughly infected these sleeves ought to be, it is necessary to watch the process of infecting mosquitos from a yellow fever case. The jar, with the sleeve attached, is placed under the bed covers, and the patient slowly slides the hand into the jar. In this way the arm and hand, the latter within the jar, rest comfortably upon the bed, under the cover, and alongside the body of the patient, the latter being often naked in this class of Spaniards. The sleeve is held around the arm. In the act of with-

drawing, the experimenter keeps the sleeve pressed against the arm and hand, thus wiping up the secretions from the surface. The number of nonimmunes who have visited the mosquito house, and have come in contact with these sleeves is considerable; but only those reported in this paper as having been bitten by infected mosquitos have contracted yellow fever.

Finally, the complete control over the spread of yellow fever that the Sanitary Department of Havana has obtained this year by the enforcement of prophylactic measures that are based solely on the doctrine of the transmission of yellow fever by the mosquito, goes very far to prove that there is no other channel of communication of the disease. A few sporadic cases have occurred, some have been imported from the interior; but in every instance the propagation of the disease has been arrested. These results have been obtained by the systematic destruction of mosquitos in every house where a case of yellow fever presented itself. If this success is interrupted, the responsibility must fall upon the physician who conceals a case of the disease. At the present writing, September 13, there is but one case of yellow fever in the city of Havana. At this time the annual epidemic is always at its height. I do not know of a more brilliant victory in the history of sanitary science. Had the American intervention in Cuba done nothing else for humanity, it may well stand upon that record, and call upon the coming years of the century to surpass it.

As to the principal object of these experiments, namely, immunization on a large scale, I regret to have to report that the desired object cannot be attained by the present methods without considerable risk to the individual. The risk, however, judging from the small number of cases of voluntary inoculation, is less than that incurred when the disease is contracted by ordinary exposure.

The cases of intentional inoculation may be tabulated as follows:

	NO. OF CASES.	DEATHS.	PERCENT- AGE.
Mosquito inoculation by the U. S. Army Commission.....	13	00	
Direct blood inoculations by the U. S. Army Commission.....	3	00	
Mosquito inoculations at the Inoculation Station.....	8	3	
Total.....	24	3	12.5

This percentage is low when we compare it with the deathrate of yellow fever in the hospitals and city of Havana, as may be seen by the following table:

Table of all cases and deaths of yellow fever in Havana, with percentage, from November 20, 1900, to August 31, 1901, divided into groups of 24 cases.

	NO. OF CASES.	DEATHS.	PERCENT- AGE.
From February 14 to August 31, 1900.....	24	6	25%
From January 2 to February 13....	24	8	33.3%
From December 16, 1900, to January 1, 1901.....	24	8	33.3%
From December 4 to December 16, 1900.....	24	7	29.16%
From November 25 to December 4, 1900.....	24	11	45.86%
From November 20 to November 25, 1900.....	24	9	37.5%
Voluntary cases, (Inoculations)....	24	3	12.5%

Previously to November 20, the cases became too numerous to be able to separate groups of 24 with their corresponding deaths, but if we take the month of August of 1900 we find that there were during the month of August, 1900, cases, 243; deaths, 48; thus giving a percentage of 19.75.



The comparatively low mortality obtained with the intentional or inoculation cases, corresponds very closely with the mortality that is obtained with a group of picked cases, that is, cases that are placed in especially favorable circumstances. For instance, the mortality at Las Animas Hospital during the epidemic of last year, was much lower among the Americans than among the Spaniards; the former came to the hospital much earlier than the latter. The mortality among the Americans corresponds exactly with the one obtained in our inoculation cases, namely 12.5%.

We may conclude, therefore, that the intentional inoculation gives the patient the better chance of recovery, and, as stated by Dr. Gorgas, in his Report of Vital Statistics for August, 1901, "when a nonimmune is going to be exposed to yellow fever, it is better to be inoculated, and have the disease under circumstances where he can be put to bed early and be treated from the beginning, than to take it accidentally."

Finally, I would suggest that in making these inoculations for purposes of immunization, not more than 1 mosquito should be employed for each inoculation, and, of course, that whenever a group of mosquitos infected from 1 case should show a very decided virulence, their use should be abandoned.

## A CASE OF PERFORATING TYPHOID ULCER: LAPAROTOMY: RECOVERY.

BY

WM. L. RODMAN, A.M., M.D.,  
of Philadelphia.

Professor of Surgery and Clinical Surgery in the Woman's Medical College of the State of Pennsylvania, and Professor of Surgery and Principles of Surgery in the Medico-Chirurgical College of Philadelphia.

CASE.—Alice P—, aged 12, was admitted into the Woman's Hospital June 18, 1901, with a more than usually severe case of typhoid fever. Pulse and temperature were high from the outset. Gastrointestinal irritation was marked, there being vomiting and diarrhea—at times so many as five and six movements a day. The vomiting was easily controlled by medication and judicious feeding, and did not recur until the end of the first week in July, when it became more aggravated than it had ever been, and persistently resisted all medication. I quote from the hospital notes furnished me. "She retained scarcely anything on her stomach, for more than a week." "The nervous symptoms at this time were marked, as evidenced by great restlessness, twitching and trembling of arms and hands. The nights were still fairly good." Pulse and temperature were high; the former being from 148 to 150, the temperature between 104° and 105°. "On July 11, early in the morning, she complained for a short time of severe abdominal pain. This pain was followed by a chill lasting 20 minutes; the temperature, however, not varying much during nor after it." "On the morning of July 12 distention was marked, and tenderness was absolutely gone from the abdomen." "The kidneys acted variably. The first urinalysis made, June 19, being as follows: Color, yellow, clear; specific gravity, 1.012; reaction acid; albumin, a trace; no sugar; urea, 4%; indican test, negative. The microscope showed epithelium and amorphous urates only. On June 22 a small amount of urine was excreted, but there was no albumin. Hot-water bag at the time remedied this. Nothing further of note, in fact, as to quantity or constituents until July 11. From that time until the operation the patient was passing a very small quantity of urine."

The pulse was so frequent and of such poor volume that digitalis, strychnin, nitroglycerin, caffeine, strophanthus and alcoholic stimulants were freely used. Tub baths to control the high temperature were tried, but were so disagreeable to the little patient, and she complained so bitterly of them, that they were abandoned, and sponging with tepid water was substituted. On the morning of July 12, at three o'clock, the temperature was 104.2°, pulse 140. At 9 a. m., the temperature was 101°, and at 12 had dropped to 96.2°. The pulse-rate at this time was 136. "At the time of the discovery of the low temperature an opium suppository, one grain, was given at once, and external heat applied. A second opium suppository, half grain, was given at 3 p. m., and whiskey and strychnia continued as before. Turpentine stupes were applied to the abdomen. The distention of the abdomen was greatly increased. The afternoon of July 12 was a very comfortable one as opium suppositories

were given every three hours." "The temperature remained subnormal until 9 o'clock in the evening, when it was 99°, the pulse being 130. July 13, at 1.30 a. m., temperature was still 99°, but at 3 a. m. had risen to 102.2°. Turpentine stupes were then changed for ice to the abdomen. Distention was very great. Patient had a very restless night. At 8 a. m. ice was removed and stupes were again applied as before, every two hours. The patient was then vomiting at very frequent intervals a greenish material. Respirations were slower, 16 to 17, and pupils were contracted. At 3 p. m.  $\frac{1}{16}$  grain of atropin was given. Pulse was very rapid and feeble all afternoon, the rate being above 150 (see chart). Spts. camphor, grs. x, administered subcutaneously. Again at 7.30,  $\frac{1}{16}$  grain of atropin was given. The abdomen was like a very tight drum."

"At 9 p. m., Dr. John H. Musser was called in consultation to meet Dr. Elizabeth Bundy, an earlier appointment in the forenoon having been misunderstood. It was thought that perforation had undoubtedly taken place on the previous day. General peritonitis was marked. Operation was considered and thought advisable, notwithstanding that the patient was in bad general condition. Dr. Rodman was asked to see the case."

I reached the Woman's Hospital shortly before 11 o'clock; concurred in the diagnosis of perforation, and consented to operate, notwithstanding the grave condition of the patient, she being in general peritonitis with a pulse beyond 150, of very small volume; it could scarcely be counted.

The tympany was enormous, and the patient was vomiting at short intervals. The parents being present we explained to them the great peril the child was in, and that there was little chance for her recovery; none without operation, and but little with it. I candidly told them that it was not unlikely that she would die upon the table. After fully understanding matters, both father and mother agreed that the operation should be done as a "dernier ressort." Preparations were at once made for the operation. I again quote from the hospital notes furnished me:

"Operation by Dr. Rodman, Dr. Everitt assisting; patient on table at 11.25 p. m. July 13; ether begun at 11.26; incision in median line four to five inches long; spts. camphor m. xii administered hypodermically; pulse varying from 160 to 170; at 11.39 perforation found almost directly under the incision, no time at all lost in searching; 11.40, caffeine  $\frac{1}{2}$  grain hypodermically; 11.42, hypodermoclysis in left thigh; 11.44, atropin  $\frac{1}{16}$  grain hypodermically; the intestine was closed with Lembert sutures; 11.47, suturing completed; copious flushing with hot saline solution; 11.49, strychnia  $\frac{1}{16}$  grain hypodermically; abdominal wounds closed by through-and-through sutures; a large piece of iodoform gauze packed in tightly over sutured bowel, and left near upper end of wound; drainage tube introduced near lower end of wound; 11.53, pulse 155; 11.54, ether stopped, arms rubbed gently with alcohol; hot cloths on chest and abdomen; spts. camphor m. xv administered hypodermically; time of operation, 16 minutes; at 12 midnight, patient off the table on stretcher; hypodermoclysis given again in right thigh at 12.10.

Pulse 183, temperature 101.6°.

Pulse dropped to 158 in 15 minutes, and at 12.45 it was only 134.

As will be seen from the notes the perforation lay almost immediately under the incision, and no time was lost in searching for it. I was led to it at once on account of the collapsed state of the intestine at that point. Elsewhere the intestines were greatly distended. The perforation was large enough to admit the point of a finger, and when the intestine was brought out of the abdomen, milk and fluid feces flowed from the wound in a steady stream the size of my little finger. As to the amount of extravasation into the peritoneal cavity, I am uncertain; peritonitis was marked, however, there being large flakes of lymph all over the intestines. I did not lose time in paring the edges of the perforation, being convinced on the one hand, that it was unnecessary, and on the other, fully realizing that no time could be unnecessarily wasted. But a single layer of sutures was used; although I had confidence in the sutures holding, I packed iodoform gauze over the opening, so as to protect the line of sutures, and also to aid in drainage. A large amount of gauze was used. I also thought it safer to place a glass drainage tube at the lower angle of the wound.

The accompanying chart shows the pulse rate and temperature during the night.

When I went to the hospital the following morning at 10 o'clock it was with the expectation of making an autopsy; I found, to my surprise, the little girl was doing fairly well; pulse being 148, temperature 101.8°, respirations 20. She was still vomiting at frequent intervals a greenish-brown material. She had been very restless during the night; the notes stating that "her legs and arms were moving almost all the time." She was catheterized at 10 o'clock, and 6 ounces of urine withdrawn. This was encouraging inasmuch as she had passed but a few ounces of urine the day before.

After consultation with Dr. Everitt an enema of glycerin was ordered, and it was followed by a large dark movement. She was allowed to take during the early morning, bits of ice, and later on small quantities of hot water by the stomach. She was also given a small amount of nourishment and whiskey by the bowel;  $\frac{1}{16}$  of a grain of strychnia hypodermically was ordered every four hours. We directed that  $\frac{1}{2}$  of a grain of calomel be placed on her tongue every half hour until a grain

<sup>1</sup> Read before the Pennsylvania State Medical Society, September 26, 1901.